STUDIES ON THE SILPHINÆ[1]

By MELVILLE H. HATCH

The purpose of the present study is (1) to discuss the genera of living and fossil Silphinæ, (2) to construct a synoptic table to the described larvæ, (3) to consider the North American species of Silphinæ, (4) to delimit more precisely their ranges,[2] (5) to consider their relationship with the extra-Nearctic species, (6) to consider the natural groupings and interrelationships of the species of *Nicrophorus*,[3] (7) to make known the contents of an extensive collection of *Nicrophorus* secured by the author from Mr. John W. Angell, of New York City, in 1922, and (8) to review the known fossil Silphinæ.

Types, unless otherwise indicated, are in the collection of the author. Concomitantly with the present studies, the author has been engaged in the preparation of the portion on Silphidæ, exclusive of Bathysciinæ, for the Junk-Schenkling *Coleopterorum Catalogus* (Pars 95), and must refer the reader there for bibliography. Furthermore, in an investigation published in connection with a paper entitled "Studies on the Carrion Beetles of Minnesota, Including New Species" (Univ. Minn. Agr. Exp. Sta. Tec. Bull. 48, 1927, 19 pp.), the author has delimited the Silphinæ as a subfamily of Staphylinidæ.

Acknowledgments are due Mr. John W. Angell for favors too numerous to mention; Mr. J. B. Wallis for information on the composition of the Manitoba fauna; Mr. F. S. Carr for similar

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[1] Contribution from the Department of Zoölogy of the University of Minnesota.

[2] M. Gaston Portevin in his most excellent work on *Les Grands Nécrophages du Globe*, (270 pp., 201 fig., Ency. Ent. VI, 1926, Paris), too frequently uses the expression "toute l'Amérique du Nord" in describing the range of species. There is not a single species of the group whose range even approximately conforms to this description!

[3] This is the original spelling of the genus, and the one adopted in all systematic works between the date of its description in 1875 and its change to *Necrophorus* in the *Systema Eleutharum* of Fabricius in 1801.

information on the fauna of Alberta; Prof. E. O. Essig for larvæ of *Silpha ramosa* Say; Prof. R. A. Cooley for larvæ of *Silpha bituberosa* Lec.; Miss Helen R. Parker for assistance in preparing the plate; Dr. Walther Horn of the Deutsche Entomologische Institut for the loan of specimens of *Apatetica, Ecanus,* and other material.

I. GENERAL CLASSIFICATION

In order to outline the general interrelationships of the Silphinæ, the following keys to imagoes and larvæ are presented. In these, as in the other keys of the present study, an attempt is made to indicate relationships as well as to furnish a means for identification. In the key to the imagoes of the Lyrosomini[4] and Agyrtini all the genera known are included. The key to larvæ includes all the genera of which the larvæ have been adequately described, though I know of *Necrophilus, Xylodrepa, Phosphuga,* and *Ablattaria* from descriptions only. In addition to descriptions and figures I am indebted to the following keys of silphine larvæ: Henriksen, Danm. Faun. Bill. V, 1922, pp. 252–260; Ganglbauer, Käf. Mitteleur. III, 1899, p. 168; Karsh, Ent. Nachr. X, 1884, p. 226; Reitter, Naturg. Ins. Deut. III (2), 1885, p. 284.

KEY TO IMAGOES

A1. Elytra nine-striate, rarely with the striæ becoming obsolescent and the elytra becoming transversely strigose.

B1. Antennæ filiform; abdomen with 6 visible sternites. **LYROSOMINI.**

C1. Elytra entire.

D1. Posterior coxae contiguous.

E1. Body elongate, subdepressed.

F1. Tibia feebly spined without; penultimate tarsomere simple; tarsi slender; Asia, Pacific Coast of North America, Mexico; (type *Necrophilus tenuicornis* Lec.).....**Apteroloma** Hatch

F2. Tibia strongly spined without; penultimate tarsomere bilobed; tarsi short; Japan, Yunnan.

Brachyloma Port.

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[4] Through the removal of *Pteroloma forstroemi* Fröl., from Silphinæ, Lyrosomini Horn 1880 must replace Pterolomini as the name of the first tribe of the subfamily.

E2. Body subhemispherical; penultimate tarsomere bilobed; Himalayas .....**Sphaeroloma** Port.*

D2. Posterior coxæ separated; 6th abdominal sternite only slightly visible; Japan to Alaska.....**Lyrosoma** Mann.

C2. Elytra truncate; Oriental .....**Apatetica** Hope.

B2. Antennæ gradually clavate.

C1. Pronotum wider than long.

D1. Posterior coxæ separated; abdomen with 6 visible sternites; elytra at base with minute strially arranged punctures, at apex smooth; Nearctic.

CATOPOCERINI, Catopocerus Mots.†

D2. Posterior coxæ contiguous; abdomen with 5 visible sternites in ♀, 6 in ♂ .....**AGYRTINI.**

E1. Pronotum as wide as elytra; body subdepressed.

F1. Elytra not transversely strigose, distinctly striate.

G1. Elytra entire.

H1. Ultimate segment of antenna no longer than penultimate; terminal segment of palpus thickened, twice as long as the next; antennæ feebly clavate; mesosternum simply carinate in front; body more elongate; pronotum widest at base, smaller in proportion to elytra and less transverse than in the succeeding genera; Palaearctic and Pacific Coast of North America, (one species from Upper Miocene of Florissant, Colo.).

Agyrtes Fröl.

H2. Ultimate segment of antenna longer than penultimate; terminal segment of palpus cylindrical, 1½ times as long as the penultimate segment; body and pronotum more transverse.

I1. Antennæ feebly clavate; mesosternum simply carinate in front.

J1. Pronotum with distinct but rounded hind angles, widest at base, sides deplanate; Japan to

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* I place in this genus, though somewhat tentatively, *castaneicolor* and *gibbus* Champion (Ent. Mo. Mag. LIX, 1923, p. 48) described from the Himalayas as *Necrophilus* subg. *Necrophiloides* nov., and separated from the true *Necrophilus* by their nearly filiform antennae and extremely convex body.

† = *Pinodytes* Horn, Portevin, Misc. Ent. XXVI, 1923, p. 2.

Alaska, Washington and Alberta .....**Pelatines** Cock.

J². Pronotum without hind angles, broadly rounded, widest before base, sides not deplante; Germany to Siberia.

Ecanus Steph.

I². Antennæ strongly clavate with a strongly differentiated club which is evidently pubescent, the basal 6 segments glabrous; mesosternum with a low carina in front of which is an elevated area furrowed throughout its entire length; pronotum at base; Holarctic, ? New Zealand .....**Necrophilus** Latr.

G². Elytra abbreviated, truncate.

H¹. Antennæ feebly clavate; last three segments of abdomen exposed; antennæ apparently 10-segmented (perhaps 11-segmented), feebly dilated towards apex; elytra with eight visible striæ; Upper Miocene of Florissant, Colo.

Miosilpha Wick.

H². Antennæ with wide club of 5-segments; Japan, India.....**Nodynus** Waterh.

F². Elytra transversely strigose.

G¹. Mesosternum carinate in front; pubescent; striæ except sutural reduced.

H¹. Scarcely striate; Chile....**Agyrtodes** Port.

H². Not striate; New Zealand.

Ragytes Port.*

G². Mesosternum simple in front.

H¹. ♂ with mesotarsi simple and last abdominal sternite entire; Chile.

Dasypelates Port.

H². ♂ with mesotarsi dilated and last abdominal sternite excavated; Chili.

Eupelates Port.

E². Pronotum narrower than elytra; body oval, almost hemispherical; Greece, Syria .....**Ipelates** Reitt.

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* Portevin (Ann. Soc. ent. Belg. LVIII, 1914, p. 197) suspects that *Catopsolius* Sharp, *Inocatops* Broun, and *Asaphaerites* Broun, all from New Zealand, may be Agyrtini, but Jeannel (Arch. Zool. exp. gen. LXI, 1922, p. 40) regards them as Camiarinae (Catopidae).

C2. Pronotum longer than wide, strongly convex, strongly emarginate in front and sinuate at sides, finely margined throughout; 4–5 mm. long; Madagascar, Natal.

EUSTADIINI, Eustadia Fairm.

A2. Elytra tricostate or less....**SILPHINI, NECRODINI, NICROPHORINI.**

KEY TO LARVÆ

A1. Ocelli 6 on each side, rarely 5.

B1. Hind angles of thoracic tergites not produced.

C1. Campodeiform.

D1. Prothorax very little narrower than mesothorax; dorsal plates without paler side margins, side margins not appreciably expanded; second abdominal sternite undivided.

E1. Caudal margin of abdominal tergites immediately mesad of hind angles with two to three bristle bearing tubercles or dentiform processes.

Necrophilus Latr.

F1. Necrobious and saprobious.

hydrophiloides Mann.

F2. Geobious .....**subterraneus** Dahl.

E2. Caudal margin of abdominal tergites without processes; necrobious.....Subg. **Thanatophilus** Sam.

F1. Pronotum without side margin, feebly rounded; 2nd antennal segment with a small preapical knob below; 18 mm. long.

rugosa L., **dispar** Hbst.

F2. Pronotum with side margins.

G1. Second antennal segment with small preapical knob. .....**lapponica** Hbst.

G2. Second antennal segment without knob; side margins of pronotum not rounded; 16 mm. long .....**sinuata** F.

D2. Pronotum somewhat narrower than mesonotum; dorsal plates with feebly expanded and paler side margins; second abdominal sternite divided into three parts; necrobious.....**Necrodes littoralis** L. and **surinamensis** F.

C2. Blattiform; pronotum produced in front with oblique and somewhat sinuate side margins; dorsal tergites moderately expanded at sides and paler.....**Diamesus osculans** Vig.

B2. Blattiform; hind angles of thoracic tergites produced; margin of dorsal plates expanded; second abdominal sternite a single piece.

C1. Pronotum nearly as long as wide with a deep transverse groove behind its front margin; margins of dorsal tergites not paler; only 5 ocelli; on trees.

(**Xylodrepa** Thoms.) **quadrimaculata** Sch.

C2. Pronotum transverse.
D1. Pronotum not covering head.
E1. Pronotum strongly emarginate in front; margins of dorsal tergites strongly expanded, paler; necrobious. (**Oiceoptoma** Sam.) **thoracica** L., **noveboracensis** Forst., **inaequalis** F.
E2. Pronotum feebly emarginate to arcuate.
F1. Antennæ not extending beyond pronotum.
G1. Pronotum feebly emarginate (not emarginate in first and second instars of *bituberosa*); margins of dorsal tergites narrowly expanded.
H1. Dorsal plates with pale side margins; phytophagous.....(**Blitophaga** Reitt.)
I1. Dorsal plates glabrous (?) **opaca** L.
I2. Dorsal plates with short hairs. **bituberosa** Lec.
H2. Dorsal plates with black side margins.
I1. Pronotum emarginate in front as in *Blitophaga*. (**Heterosilpha** Port.) **ramosa** Say.
I1. Pronotum more strongly rounded in front; phytophagous. (**Aclypea** Reitt.) **undata** Müll.
G2. Pronotum distinctly arcuate in front; margins of dorsal plates moderately expanded, not paler; necrobious. (**Necrophila** Kly.) **americana** L.
F2. Antennæ extending beyond mesonotum, the third segment elongate (**Ablattaria** Reitt.) **laevigata** F. (**Phosphuga** Leach) **atrata** L.
D2. Pronotum nearly or completely covering head, strongly arcuate in front; margins of dorsal tergites strongly expanded; necrobious.....(**Silpha** (s. str.))
E1. Head not completely covered by pronotum.
F1. Third antennal segment longer than second; tergites shining, finely pubescent; side processes of tergites tri-colored, pale behind; base of pronotum covered by metanotum; 22 mm. long. **tristis** Ill.
F2. Third antennal segment no longer than second; tergites opaque, densely pubescent; side processes of tergites unicolored; 20 mm. long. **carinata** Hbst.

E². Hind portion of head completely covered by pronotum; third antennal segment no longer than second; tergites dull, densely pubescent, side processes tricolored, pale behind; base of pronotum not covered by metanotum; 18 mm. long.....**obscura** L.

A². Ocelli 2 on each side; eruciform; abdominal tergites small, with four spines at base; necrobious; sternites absent.....**Nicrophorus** F.

B¹. Ninth tergite without lateral teeth; cerci short, not reaching beyond ninth segment; mandibles without teeth at apex; third segment of palpi not longer than second; color yellowish; 27 mm. long .....**vespillo** L.

B². Ninth tergite with lateral teeth; cerci longer, extending beyond ninth segment; mandibles with 6 or 7 evident teeth; color whitish.

C¹. Basal segment of cerci firmly united with ninth tergite without an intervening suture; third segment of palpus 1/3 longer than second; 23 mm. long.....**vespilloides** Hbst.

C¹. Basal segment of cerci with evident suture separating it from ninth tergite; third segment of palpus as long as second.

D¹. First segment of cerci 4 times as long as broad, width about 1/6 that of tergite; 27 mm. long.
investigator Zett.

D². First segment of cerci twice as long as broad; width about 1/8 that of tergite; length 33 mm.....**humator** Oliv.

The suggestion is put forth that the groups with nine-striated entire elytra, cordate pronotum, filiform antennæ, and a campodeiform larva with bisegmented cerci and without lateral expansions on the dorsal plates represent the primitive condition of the subfamily.

Larvæ.—Though the campodeiform larva of *Necrophilus subterraneus* is the only lyrosomin or agyrtin larva known, it is probably safe to assume that the general larval type of these tribes is campodeiform, and the same type of larva is found in *Thanatophilus*. The larval types of the higher Silphinæ exhibit three lines of modification: (1) The necrodin larva in which the lateral margins of the tergites are moderately expanded, but without the posterior angles of the thoracic tergites being produced. In *Necrodes* the larvæ are campodeiform; in *Diamesus* they are so broad as to warrant the designation blattiform. (2) The eruciform, fleshy larva of *Nicrophorus* with feeble powers of locomotion, and that spends its life in the carcass where the eggs have been laid by the parent. (3) The flattened blattiform

larvæ of the *Blitophaga-Necrobora-Oliceoptoma-Silpha* series in which the side margins of the tergites become more and more expanded, the posterior angles of the thoracic tergites become produced, and the pronotum eventually comes to cover the head completely.

Elytra.—The tricostate elytra has, perhaps, been derived from the 9-striated one by the elevation of alternate elytral intervals, as exhibited in *Necrophilus pettitii* Horn.

Pronotum.—Four types of pronotum are exhibited by the Silphinæ. (1) The cordate type in which the basal portion is constricted so that it is narrower than the base of the elytra, the hind angles distinct, and the margins just anterior to the hind angles sinuate. This type occurs in *Lyrosoma,* in certain species of *Apteroloma,* and elsewhere, and is regarded as the primitive type. (2) The silphoid type, narrowed anteriorly with the hind angles not distinct, exemplified by certain species of *Apteroloma, Necrophilus, Silpha,* and *Diamesus.* (3) The orbicular type of *Necrodes* and certain groups of *Nicrophorus.* (4) The posteriorly narrowed type, but absolutely without evidence of hind angles, in the remaining species of *Nicrophorus,* in *Ptomaphagus,* and the fossil *Palaeosilpha.* The first type is found only in the 9-striated genera. The second type is found in both 9-striated and tricostate genera. The third type is found only in tricostate genera and *Nicrophorus,* and is regarded as primitive for the Nicrophorini. The last type is peculiar to the *Nicrophorini* and, in the author's opinion, is the key to the elucidation of that genus.

Silpha.—The primitive condition of the genus is probably that with a simple tricostate elytra and a tuberosity between the second and third costæ about two-thirds of the distance to the apex. Among derivative types may be mentioned *Necrophila** and *Heterosilpha* in which the costæ tend to break up into a general reticulation, certain species of *Thanatophilus* with rows of tubercles between the costæ, *Ptomaphila* in which the striæ are broken up to form rows of tubercles, certain species of *Silpha* (s. str.)

* = *Necrobora* Hope 1840. *Necrophila* Kirby 1837 (type *Silpha americana* L., the same as *Necrobora*) is not a homonym of *Necrophilus* Latr. 1829, and, consequently, is the valid name for this subgenus.

in which the tuberosity is obsolete, *Philas* in which the striæ are obsolete, and *Silphosoma* in which the pronotum is abnormally reduced. *Phosphuga* and *Ablattaria,* far from deserving first place as in Portevin's classification, are among the most specialized groups of the genus. In both the elytral tuberosity is obsolete, the head is greatly narrowed, and the food consists of snails, in my view all specialized characters. *Ablattaria,* furthermore, has the elytral striæ obsolete.

Nicrophorini.—The bifasciate elytra of *Diamesus* and *Necrodes* (*Protonecrodes*) *surinamensis* ab. *bizonatus* Port. are probably homologous with those of *Nicrophorus,* and probably represent the acquisition of a new character, since this feature is entirely absent in *Silpha* and the lower Silphinæ. The Nicrophorini are further derivative in that (1) the second and third segments of the antenna have fused, leaving the antenna ten-segmented, (2) all evidence of the elytral costæ is wanting, (3) the legs are shorter and fossorial, (4) the antennal club is usually capitate, though simply clavate in *Ptomaphagus,* (5) the pronotum is frequently narrowed posteriorly, (6) the larvæ are eruciform and apparently present the first stages of a degeneracy similar to that exhibited by other larvæ leading their entire existence in the midst of their food supply (*e.g.,* fly-maggots and many Hymenoptera), in which there is a lessened need for agility or powers of rapid locomotion.

II. NECROPHILUS LATR.

KEY TO SPECIES

A1. Disc of pronotum sparsely punctate; rows of punctures on elytra impressed; intervals similar.

B1. Apex of elytra arcuate to suture, not prolonged; winged; metasternum long, normal; striæ equally punctate throughout; seventh interval not elevated at humerus; abdominal tergites largely membranous; length 9–11 mm.; Alaska to central California.

hydrophiloides Mann.

B2. Apex of elytra prolonged and abruptly bent downward; striæ with coarser punctures on apical and latero-apical portions; seventh interval elevated at humerus; length 10 mm.; New Zealand.

prolongatus Sharp.

A2. Disc of pronotum impunctate; elytra narrowly truncate at extreme apex; apterous; metasternum shorter.

B1. Elytral truncature sinuate, but without the sutural angle being sharply dentate; metasternum longer than metacoxa; rows of punctures on elytra feebly impressed, the second, fourth, and fifth intervals more prominent basally than the others; length 11 mm., rare (in fungi): Ont., Ind., Ohio, Ken., Tenn., N. C., N. Y. **pettitii** Horn.

B2. Sutural angle of elytra sharply dentate; metasternum shorter than metacoxa; rows of punctures on elytra distinctly impressed, intervals similar; abdominal tergites except first corneous; length 6–8 mm.; alpine regions of central Europe.....**subterraneus** Dahl.

The Siberian *picipes* Mots. (Bull. Soc. Nat. Mosc. 1845, p. 52) of somewhat doubtful identity is not included. There is little doubt that *hydrophiloides* is more closely related to *subterraneus* Dahl. than to *Ecanus* Steph., on the basis of the characters set forth in the key to genera. *Subterraneus* and *pettitii* are about the only species of Silphinæ that, in their distribution, suggest a North Atlantic connection between North America and Eurasia. All the other affinities exhibited in the subfamily between the two regions can be better explained by way of Bering Strait.

III. SILPHA AND NECRODES

Portevin's revision, previously mentioned, includes the species belonging to the tribes Nicrophorini and Silphini of Ganglbauer. From the latter of these he segregates *Necrodes, Protonecrodes,* and *Diamesus* to constitute the *Necrodini,* and the sequence of the tribes is Silphini, Necrodini, Nicrophorini. Of Silphini he recognizes twenty genera and three subgenera, and of the other tribes three genera each.

While adhering to this sequence of tribes, I prefer to consider the twenty genera and three subgenera of Silphini all subgenera of a single genus, *Silpha.* Furthermore, I consider *Protonecrodes* a subgenus of *Necrodes* and *Necrocharis* a subgenus of *Nicrophorus. Acathnopsilus* represents a tendency within *Nicrophorus* of relatively slight significance and can be considered a synonym of that genus. With this one exception, the changes that I propose do not involve the validity or naturalness of any of Portevin's groups, but merely their relative rank. It is generally admitted that objective generic characters or objective genera do

not exist. The only objective criterion that can be applied is that a genus must contain no species that is less closely related to the type than to the species of some other genus. The argument in favor of the reduction of the genera mentioned above may be formulated as follows.

Genera are primarily for convenience, provided only that they be natural groups. Taxonomy must not become autotelic, but must serve as the handmaiden of the other biological disciplines. If the validity of the binomical nomenclature is granted, the demand of the general zoölogist and others who are not specialists in the several groups that generic names be sufficiently inclusive and characteristic to enable them to use and appreciate them is not an illegitimate one. Systematic zoölogy warrants their criticism if it fails to meet this demand. The requirement of the specialist for a more adequate grouping is entirely met by the introduction of subgenera and species-groups, which the general student can utilize at his discretion.

The same remarks apply to species. I tend to look upon a species as a group of interbreeding organisms that may exhibit considerable structural variation. Man, *Homo sapiens* L., is a typical species, and the differences between the several "races" or subspecies of man are typical of the degree of variation that may occur within a species. Subspecific variations that are correlated with geographical distribution may be termed *subspecies* or races. Other subspecific variations may be termed aberrations, though Portevin apparently recognizes three categories: (1) variations in color pattern or *aberrations,* (2) variations in sculpture and color of pubescence or *varieties,* and (3) variations in the general pigmentation of the exoskeleton or *accidents.* As will be seen in those portions of the present paper that treat of *Nicrophorus,* while retaining a comparatively conservative conception of species, I have insisted upon a rather minute classification of the aberrations. The species or, at most, the subspecies, will be all that will, presumably, concern the ecologist or general biology. Taxonomy would, however, fail in its primary descriptive function if it neglected to take cognizance of the variation which is considered aberrational, and the aberrations will be of

interest to those concerned with the problems of subspecific and individual variation.

In the following key to the Nearctic species of Silphini and Necrodini, *Necrodes* because of its orbicular pronotum is placed last, and *Oxelytrum* Gistel. is placed next to it because of its many necrodin features, as prominent eyes and elongate form. *Thanatophilus* is placed first because of its campodeiform larva, and, associated with it by the form of its labrum, is *Oiceoptoma* with its strongly blattiform larva, and *Philas*, larva unknown, with smooth elytra. The remaining subgenera with narrowly emarginate labrum are placed in the sequence *Blitophaga, Heterosilpha, Necrophila, Silpha* on the basis of their increasingly blattiform larvæ.

KEY TO NEARCTIC SILPHA* AND NECRODES

A1. Prothoracic spiracles covered; pronotum not orbicular.....**Silpha** L.

B1. Eyes not prominent; form less elongate.

C1. Labrum broadly emarginate; antennæ inserted close to eye and distant from margin of front.

D1. Elytra costate, not squarely truncate.

E1. Pronotum emarginate at base.

(**Thanatophilus** Sam.)

F1. Intervals of elytral costæ flat.

G1. Two inner elytral costæ subequal throughout; Alaska, Alb., Man., Minn., Mich.....**trituberculata** Kby.

G2. Two inner elytral costæ nearly obsolete at base; Colo., Brit. Col. **coloradensis** Wick. (**obalskii** Port.)

F2. Intervals of elytral costæ tuberculate; arctic Europe and Asia, Greenland, Alaska,

* In 1924 and 1925 a few individuals of *Silpha* (*Xylodrepa*) *quadripunctata* Schrb. were introduced from Europe into Massachusetts in the hope that they might establish themselves as predators on the gipsy moth (Crossman, Jr. Econ. Ent. XVIII, 1925, p. 172, and correspondence.) Mr. Crossman writes me, however, that no further attempt to introduce the species will be made, that it is of slight importance, the larvæ do not climb trees, no specimens have been recovered, and the species has probably not established itself. If taken, they may be distinguished from our other species by their light brownish elytra and basal and lateral marginal areas of the pronotum. The disc of the pronotum, scutellum, and two spots on each elytron, one basal and the other just behind the middle, are black.

Northwest Terr., and Labrador to D. C., Penn., Mich., Wisc., Iowa, Kans., New Mex., and Calif.; Mexico, (?) Bolivia.
lapponica Hbst.

G1. Head and pronotum with long pubescence.

H1. Base of elytra strongly punctate; humeri feebly dentate; north of Calif. and Mexico.
type.

H2. Base of elytra finely punctate; humeri strongly dentate; Calif., (?) Bolivia.
subsp. *caudata* Say.

G2. Head and pronotum with shorter pubescence; Mexico.
subsp. *granigera* Chev.

E2. Pronotum not emarginate at base.
(**Oiceoptoma** Leach.)

F1. Elytral punctation fine; pronotum unicolorous; Maine, Ont., northern penn. of Mich. and (?) Man. to Iowa, Kans., (?) Colo., and Fla.; Mexico and Guiana (Portevin).
inequalis Fab.

G1. Color deep black.

H1. Basal portions of elytra not rugose; humeral tooth feeble; inner two elytral costæ more elevated at apex; north of Georgia .....*type.*

H2. Elytra rugose throughout; humeral tooth strong; elytral costæ equal throughout; Ga., Fla., Mexico and Guiana (Portevin).
subsp. *rugulosa* Port.

G2. Color brownish with disc of pronotum somewhat darker; N. Y. (Type: Rosedale, L. I., F. M. Schott, June 30, 1918), N. J.....acc. *bicolorata* nov.

F2. Elytral punctation coarser; pronotum black with reddish margins; N. S. and Man. through Iowa to Okla., Ill., Ind., and N. C.....**noveboracensis** Forst.

D1. Elytra not costate; squarely truncate at apex; Ore., Colo. and Kans, to s.w. Tex. and n. Sonora, but not in Calif.; (?) Venezuela.
(**Philas** Port.) **truncata** Say.

C2. Labrum narrowly emarginate.

D1. Antennæ inserted close to margin of front and more distant from eye.....(**Blitophaga** Reitt.)

E1. Form elongate-oval; surface pubescent; palaearctic, Man., Calif., (?) Colo., N. J.....**opaca** L.

E2. Form oblong-oval; surface sparsely pubescent; Kans., Colo., Nebr., "Dak.", Wyom., Man., Mont., Idaho, Ore., Alb., Sask.....**bituberosa** Lec.

D2. Antennæ inserted close to eye and distant from margin of front.

E1. Body metallic below; elytral intervals reticulate.

F1. Oblong-oval; uniform black above.
(**Heterosilpha** Port.)

G1. Elytra not bronzed; elytral apex prolonged in ♀; Wash., Alb., Man., and Wisc. to Colo., N. Mex., n. Sonora, Calif., and Lower Calif...**ramosa** Say.

G2. Elytra and pronotum bronzed; elytral apex not modified in ♀; Calif.
aenescens Csy.

F2. Broadly oval; pronotum black with yellow margins; Man., n. Ont., and N. S. to Kans., N. Mex., and Fla.; Mexico and Guiana (Portevin).
(**Necrophila** Kby.) **americana** L.

G1. Elytra dark.

H1. Apex of elytra dark.....*type*.

H2. Apex of elytra yellowish.
ab. *affinis* Kby.

G2. Elytra brownish; Md. (Type in Univ. of Minn. coll.).
acc. *brunnipennis* nov.

E2. Body not metallic below; elytral intervals not reticulate; alpine central Europe; (?) Kansas.
(**Silpha** L.) **tyrolensis** Laich.

B2. Eyes prominent; form elongate; pronotum black with roseate margins; Southern Calif. to Peru, Argentina, and Brazil.
(**Oxelytrum** Gistel.) **discicollis** Br.

A2. Prothoracic spiracles exposed; pronotum orbicular; form elongate; usually with orange bar or row of spots across elytra towards apex; eyes prominent; antennæ inserted close to eyes and distant from

margin of front; Nfld. and Alb. southward to the east of the Rocky Mts. through Mont. and Kans. to Ariz., Tex., La., and n. Georgia; n. South Amer. (Portevin).

Necrodes Leach (**Protonecrodes** Port.) **surinamensis** F.

B1. With evidence of basal elytral bar.....ab. *bizonatus* Port.

B2. Without evidence of basal elytral bar.....*type.*

Distribution.—Of the nine Nearctic groups of Silphini and Necrodini, three (*Philas, Heterosilpha,* and *Necrophila*) are peculiar to its fauna with only one or two species each. One species (*discicollis* Br.), represented by a single specimen in the author's collection from southern California, belongs to the Neotropical *Oxelytrum* Gistel. The subgenus *Silpha* is represented by two specimens of *tyrolensis* ab. *nigrita* Creutz in the University of Minnesota collection labeled "Ka." from the Otto Lugger collection. The authenticity of this record is doubtful, and, if authentic, the specimens must have been artificially introduced from Europe. The remaining four groups are Holarctic. Of the 27 species of *Thanatophilus,* 15 are native to Palaearctic Asia, 9 to Europe, and 3 each to Ethiopian Africa and North America. Of the 5 species of *Oiceoptoma,* 3 are natives of Palaearctic Asia, 2 of North America, and one of Europe. Of the 13 species of *Blitophaga,* 10 are natives of Palaearctic Asia, 3 of Europe, and 2 of North America. The three species of *Protonecrodes* are distributed respectively in North America, Palaearctic Asia, and India. In every instance the center of distribution is Palaearctic Asia and the presumable connection with North America is by way of Bering Strait. In no instance, however, in contradistinction to the Lyrosomini and Agyrtini, are the Nearctic forms of these Holarctic groups peculiarly Pacific in distribution, and *Thanatophilus* is the only one of these groups to be represented on the Pacific Coast south of British Columbia.

Silpha (Thanatophilus) trituberculata Kby.—I found single specimens under cover on the sandy beach: two at Douglas Lake, Cheboygan Co., Mich., July 7 and 29, 1920; one at Cecil Bay, Emmet Co., Mich., July 23, 1920, on Lake Michigan. These are the only Michigan specimens known. I have no data on its habitat, but do not doubt that it is necrobious.

Silpha (Thanatophilus) coloradensis Wick.—*Obalskii* Port. is synonymous. Portevin has misinterpreted the original description and has grouped *coloradensis* with those species in which the elytral costæ are equal throughout. The species is probably generally but sparsely distributed throughout the Rocky Mountain area. Habitat unknown.

Silpha (Thanatophilus) lapponica Herbst.—Necrobious. Apparently absent from the southwestern counties of Michigan, and has not been recorded south and east of the states listed in the key.

Silpha (Oiceoptoma) inæqualis Fab.—Necrobious, breeding in southern Michigan beginning with March or early April. It apparently becomes rare towards the northern limits of its range, since extensive collecting at Douglas Lake, Mich., failed to reveal it, although it has been taken in the upper peninsula. I regard *rugulosa* Port. as the southern phase of this species, and there are specimens from Georgia in the University of Minnesota collection that appear to be intermediate.

Silpha (Oiceoptoma) noveboracensis Forst.—Necrobious, breeding in the spring. In southern Michigan both this species and *inaequalis* appear in numbers on carrion at the first opportunity in the spring. *S. inaequalis* appears first, is followed in a few days by *noveboracensis,* exists side by side with it for a few days, and then, having laid its eggs, entirely disappears, leaving the field to *noveboracensis* alone. I have taken a single specimen of *noveboracensis* in horse dung.

Silpha (Philas) truncata Say.—There is a series of five specimens of this species in the University of Minnesota collection that Dr. Oscar W. Oestland assures me were collected by one of his students in Venezuela.

Silpha (Blitophaga) opaca L.—This Palaearctic species has been reported from widely scattered Nearctic localities. My series of four specimens are said to have been taken in New Jersey. It is hardly to be regarded as a regular member of our fauna, and, since it is phytophagous, may possibly be transported with shipments of plants.

Silpha (Heterosilpha) ramosa Say and **aenescens** Csy.—According to taxonomic practice, these must be regarded as distinct species, since they differ as regards secondary sexual characters and both occur together in California. So far as I know, *ramosa* has not been recorded from Illinois, Iowa, and Nebraska or south or east of those states. The life history described by Goe (Ent. News XXX, 1919, pp. 253–255) under *S. inaequalis,* which does not occur in Oregon, is to be attributed to this species. It is necrobious, though Essig reports it as phytophagous from California.

Silpha (Necrophila) americanus L.—Necrobious. It is doubtful whether it is desirable to recognize by name variations in the discal pronotal spot. Four conditions have been noted: (1) spot single, widely separated from both fore and hind margins; (2) spot single, narrowly separated from fore margins, widely separated from posterior margin; (3) as in (2) except that spot is traversed by a narrow median yellow line; (4) spot single, narrowly separated from both anterior and posterior margin. I do not find any specimens exactly corresponding to *canadense* Kby., in which the spot is said to attain both anterior and posterior margins, unless my form (4) is it.

For the form with yellow-tipped elytra, I use the name *affinis* Kby. *Terminata* Kby. has page priority, but its use is rendered inadvisable because of the existence of *Silpha* (*Thanatophilus*) *terminata* Hummel, 1825. The aberration is much more abundant than the type, and it is possible that the type of *americana* L. really has the elytral apices yellow.

Necrodes (Protonecrodes) surinamensis Fab.—Necrobious. Females full of eggs occurred at Douglas Lake, Michigan, in July. The range of color variation is indicated by the accompanying table, in which the composition of the anterior fascia is indicated by Roman numerals and that of the posterior fascia by capital letters. A and I refer to marginal spots, B and II to spots on the outer costa, C and III to spots on the middle costa, D and IV to spots on the inner costa, and E to an extra sutural spot. When the symbols are connected by a dash the spots are confluent, otherwise they are distinct. An "x" indicates that specimens are known with the particular combination indicated.

	A–B–C–D	A–B–C D	A–B C D	A B–C–D E	A B–C–D	A B–C D	A B C–D	A B C D	A B C	B–C–D	B–C D	B C D	B C	B	C	No posterior fascia
I, III, IV								x								
I, II	x			x	x											
II	x								x			x				
I	x				x	x			x	x	x	x	x			
No anterior fascia	x	x	x		x	x	x	x		x	x	x	x	x	x	x

FOOD OF SILPHA, NECRODES, AND NICROPHORUS

The evidence* is at hand to show that the adults of these groups are primarily predators on fly-maggots. The carrion may, however, serve as a partial source of food, and I have kept imagoes of *Silpha* and *Necrodes* on a carrion diet for a period of several weeks. Observations on the larvæ are less numerous, but Goe raised larvæ of *S. ramosa* and I have raised larvæ of *S. noveboracensis* nearly to maturity on a purely carrion diet.

IV. NICROPHORINI

Material.—The following attempt to elucidate the interrelationships of the Nicrophorini is based on a collection the nucleus of which was secured from Mr. John W. Angell, of New York City, in 1922. The collection represented a decade's activity on his part, and, together with important additions received from him and others since that date, has enabled the author to see all but 20 of the 64 species recognized by Portevin. Of the remaining 20, five were unknown to Portevin, three were described from uniques and one from two specimens, and three seem to be doubtfully distinct. Of the species unknown to me, *lunatus* Fisch. is the only one I am unable to place in any of my groups, though I suspect its relationship to *humator* Fab. I place *argutor* Jak. in the *marginatus* group and *oberthuri* Port., *montivagus* Lewis, *validus* Port., *encaustus* Fairm., and *chilensis* Phil. in the *vespilloides* group. Species unknown to me except from descriptions are preceded by an asterisk (*) in the tables and notes that follow.

Primitive characters.—The following characters are regarded as primitive: (1) an orbicular pronotum; (2) a glabrous dorsal surface; (3) a "normal" size; (4) straight tibiæ on all three pairs of legs; (5) pronotum entirely black; (6) elytra with two simple fasciæ—it is in accordance with this that the simply bilobed mesal end of the posterior fascia is regarded as more primitive than the trilobed condition; (7) antenna with basal

* Clark, Jr. N. Y. Ent. Soc. III, 1895, p. 61; Davis, ibid, XXIII, 1915, p. 150–151; Steele, ibid, XXV, 1927, pp. 77–81; Goe, Ent. news XXX, 1919, pp. 253–255.

segment of the club black, the three distal segments orange; (8) ventral plates of meso- and metasternum with yellow pubescense; (9) abdominal sternites with black hairs; (10) surface of elytra moderately and uniformly punctate.

The argument may be summarized as follows:

(1) Those features are regarded as primitive that are present among other Silphinæ in general and Necrodini in particular. This argument is applicable to the first six characters mentioned and is the stronger argument. It is also applicable to number (7), which condition is present in *Necrodes littoralis* F.

(2) Those characters have been regarded as primitive that are in general occurrence among the species of *Nicrophorus,* so long as this evidence is not in conflict with the first, cited above. This applies to all but the first character mentioned.

Of derivative features, those that can be measured qualitatively, like the shape of the pronotum and the shape of the fasciæ in their "typical" form, seem more reliable indices of relationship and less likely to exhibit convergence than those that are measured quantitatively as the color of the ventral pubescence, the color of the segments of the antennal club, or the curving of the middle and hind tibiæ.

The Groups.—The following key is an attempt to define the chief phyletic groups of Nicrophorini.

KEY TO GROUPS OF NICROPHORINI

A1. Pronotum margined in part; antennæ capitate.....**Nicrophorus** Fab.

B1. Pronotum orbicular, at times very feebly sinuate at sides; widely margined.

C1. Size "normal," usually under 25 mm. in length.

D2. Elytra with flying hairs; fasciæ not emarginate; Neararctic, Neotropical, Celebes.

orbicollis group (7 species).

D2. Elytra without flying hairs.

E1. Elytra maculate; fasciæ emarginate; eastern Asia to New Guinea.....**nepalensis** group (6 species).

E2. Elytra immaculate or with fasciæ greatly reduced; Palaearctic, (?) Calif.

humator group (2 or 3 species).

C2. Size larger, usually over 25 mm.; posterior tibiæ often curved; Holarctic.....**germanicus** group (9 species).

B². Pronotum transverse; sinuate at sides.
C¹. Pronotum feebly sinuate, not strongly cordate, widely margined; posterior tibiæ straight.
D¹. Three terminal segments of antennæ usually not orange; sutural extremity of posterior elytral fascia not trilobed; pronotum more quadrilateral; Holarctic, Oriental, Neotropical....**vespilloides** group (7 species).
D². Three terminal segments of antennæ usually orange; sutural extremity of posterior elytral fascia normally trilobed; pronotum less quadrilateral; Holarctic.
pustulatus group (8 species),
C². Pronotum strongly cordate, strongly sinuate at sides, less widely margined; posterior tibiæ straight or curved.
D¹. Pronotum glabrous; sutural extremity of posterior elytral fascia normally trilobed; Holarctic.
marginatus group (10 species).
D². Pronotum pubescent; sutural extremity of posterior elytral fascia not trilobed; Holarctic.
vespillo group (6 species).
B³. Pronotum oboval; lateral margin extremely narrow except at base; anterior sinuate line absent; mid-dorsal line feeble; Nearctic.
subg.**Necrocharis** Port. (1 species).
A². Pronotum transversely oval; margin wide at base, extremely narrow at apical fourth; anterior sinuate and mid-dorsal lines obsolete; posterior elytral fascia obsolete, anterior one sometimes so; antennæ gradually clavate; eastern palaearctic..**Ptomascopus** Kr. (3 species and 1 fossil).
A³. Pronotum transversely oval, without margins; anterior sinuate and mid-dorsal lines obsolete; frontal striæ short; length 14.5 mm.; Lower Oligocene of France.....**Palaeosilpha** Flach. (1 species).

Distribution.—Of the 10 phyletic groups of the tribe, 8 are eastern Palaearctic, 7 are Nearctic, 6 are western Palaearctic, 2 each are Neotropical, Oriental, and Celebean, and 1 extends to New Guinea. The only instance of discontinuous distribution is in the *orbicollis* group in which a single species is Celebean while the others are Nearctic and Neotropical. The situation is the same as in the other tribes of Silphinæ, with the center of dispersal in the eastern Palaearctic area, but the Nearctic Region is very nearly as important. All the groups occur in one or another of these two regions.

Phylogeny.—The *orbicollis* and *nepalensis* groups are the most primitive members of the genus. The *orbicollis* group appears

to be derivative in its possession of flying hairs on the elytra; the *nepalensis* group appears derivative in that the elytral fasciæ tend to be emarginate and to include black spots. The interpretation to be placed on the flying hairs is not evident. They are entirely different from the yellow pubescence of the *vespillo* group. Possibly they are primitive and the other groups have lost them; possibly, on their account, the *orbicollis* group must be considered divergent from the groups that otherwise appear to be descended from it.

Among the types of posterior elytral fasciæ in the *orbicollis* group, the feebly bilobed type in *orbicollis* appears to lead to the *vespilloides* group, the strongly bilobed type in *sayi* Lap., through its similarity with *americanus* Oliv. and *carolinus* L., appear to lead in the direction of the *germanicus* group and the subgenus *Necrocharis*. The trilobed type in *olidus* Matth. and *distinctus* Grouv. appears to lead in the direction of the *pustulatus-marginatus* groups, from which the type in the *vespillo* group can be derived by reduction.

The groups with a narrowed pronotum appear to represent two divergent lines: (1) that represented by the *vespilloides* group in which the pronotum is more distinctly quadrilateral; (2) that represented by the *pustulatus-marginatus-vespillo* groups in which the pronotum is more sinuate at the sides and becomes distinctly cordate. The affinity between the *pustulatus* and *marginatus* groups is exhibited by the similar trilobed posterior fascia. In the *vespillo* groups this latter feature is lost but the posterior fascia resembles that of the *pustulatus-marginatus* groups more closely than that of any other. Furthermore, the shape of the pronotum is very nearly that of some of the more generalized members of the *marginatus* group.

Ptomascopus and *Nicrophorus* represent divergent tendencies. As regards antennæ, *Nicrophorus* is the more derivative. As regards shape of pronotum and the elytral fasciæ, *Ptomascopus* is the more derivative.

Orbicollis Group

KEY TO SPECIES

A1. Posterior elytral fascia normally bilobed; pronotum more transverse (82% as long as wide); elytral pubescence longer.

B1. Posterior tibiæ straight; pronotum not emarginate at sides; posterior fascia with inner lobe small.

C1. Posterior trochanter normal, emarginate behind; marginal ridge of elytra attaining level of apex of scutellum; pronotum rounded at sides; Me., Ont., Man. and Alb. to Kans., Miss. and Fla.....**orbicollis** Say.

C2. Posterior trochanter truncate behind; marginal ridge of elytra not attaining level of apex of scutellum; South America.

D1. Pronotum rounded at side; epipleura mostly black; marginal ridge of elytra longer; Mexico (Portevin) to Peru, Bolivia, and Argentina; Para (Brazil), Venezuela.....**didymus** Brull.

D2. Pronotum visibly straight at sides; epipleura orange; marginal ridge not attaining basal half; Bolivia, Argentina.....**scrutator** Blanch.

B2. Posterior tibia curved; pronotum very feebly wider in front and very feebly emarginate at sides; posterior fascia with inner lobe larger; N. B., Man., and Alb. through Mont. to Iowa., Ill., Tenn., Miss., and Va.....**sayi** Lap.

A2. Posterior elytral fascia single; pronotum less transverse (86% as long as wide); elytral pubescence shorter; Costa Rica to Panama.

quadrimaculatus Matth.

A3. Posterior elytral fascia trilobed at sutural end; pronotum with a few hairs in anterior angles.

B1. Posterior tibia straight and simple; Mexico to Colombia.

olidus Matth.

B2. Posterior tibia curved and strongly dilated basally; Celebes.

distinctus Grouv.

Nicrophorus orbicollis Say.—Portevin states that the pronotum of fresh specimens bears traces of yellow pubescence, but I fail to find it in any of my extensive series. If it does exist, it might further substantiate the availability of this species as the type from which practically all the other species of the genus can be derived.

Nicrophorus didymus Brull.—Two specimens from Bolivia in my collection have the posterior fascia entire and the anterior one consisting of two spots and are hereby designated as ab. **portevini** nov.

Nicrophorus sayi Lap.—Appears to be rare south of the Illinois-Pennsylvania line, since Ulke does not record it from D. C. My two southern specimens bear the localities Suffolk, Va., and Marop, Miss.

Nicrophorus olidus Matth. and **distinctus** Grouv.—It may be supposed that the tendency to develop a trilobed posterior fascia was developed in the Holarctic area by the *orbicollis* group. Subsequently, from this stock, the *pustulatus* and *marginatus* groups arose in this region, leaving these peripheral species as the only evidence of the primitive fauna. The Celebean *distinctus* Grouv. possesses an abundance of unique features as is to be expected from its isolated habitat.

Nepalensis Group

The members of this group are distributed from eastern Siberia and Japan to northern India and New Guinea, but are not reported from the Philippine Islands. The following sequence more or less approximately indicates the relative specialization of the species: *nepalensis* Hope, *podagricus* Port., **heurni* Port., *quadrimaculatus* Kr., *maculifrons* Kr., and **maculiceps* Jak. Their extension into the Malay Archipelago is, perhaps, explained by an early geological development.

Humator Group

Includes *ussuriensis* Port., *humator* Fab., and, perhaps, *lunatus* Fisch. I am inclined to regard *tenuipes* Lew. as a subspecies of *humator*. The paratype of *Nicrophorus grandior* Angell from California is a somewhat immature specimen of *humator* Fab. so that, if this record is confirmed, this species must be added to the American list.

Germanicus Group

KEY TO SPECIES

A1. Apical angle of posterior tibia not prolonged in spine-like process.
  B1. Posterior tibiæ simple; elytra fasciate.
    C1. Disc of pronotum black; sides rounded; China.
      ***przewalskyi** Sem.
    C2. Disc of pronotum orange; sides feebly sinuate, feebly enlarged in front; N. S. and Minn. through Iowa and Kans. to Tex. and Fla.....**americanus** Fab.
  B2. Posterior tibiæ dilated and dentate; sides of pronotum feebly enlarged in front.

C1. Elytra with hypomera, an anterior fascia, and a posterior spot orange; Russian Armenia, Central Russia.
*armeniacus Port.

C2. Elytra usually immaculate, at most with a few spots orange.

D1. Antennal club blackish.

E1. Clypeal membrane orange.

F1. Hypomera paler; posterior tibiæ feebly curved; elytra rarely with orange spots; Europe, (?) Calif.....germanicus L.

F2. Hypomera not paler.

G1. Posterior tibiæ nearly straight; central Russia, Turkestan, Mongolia, eastern Siberia, Japan....morio Gebl.

G2. Posterior tibiæ feebly curved; elytra with oblique striolæ; southern China.
*rugulipennis Jak.

E2. Clypeal membrane black; Turkestan.
*nigerrimus Kr.

D2. Last segments of antenna orange; central Russia, Turkestan .....satanas Reitt.

A2. External apical angle of posterior tibia prolonged in spine-like process; prontum rounded at sides.

B1. Lateral margin of pronotum without or with indistinct plica; clypeal membrane yellow; Japan, Formosa, northern China.
concolor Kr.

B2. Lateral margin of pronotum with distinct transverse clypeal membrane brown; Tibet, Himalayas, southern China.
rotundicollis Port.

The type of *Nicrophorus grandior* Angell from California is a specimen of *N. germanicus* ab. *bipunctatus* Kr. Portevin records a specimen of this form in the Grouvelle collection labeled "Etats-Unis."

Portevin's subgenus *Acathnopsilus* was erected to include *concolor* Kr. and *rotundicollis* Port., which, in my opinion, are only more or less derivative members of the *germanicus* group.

Vespilloides Group

Vespilloides Hbst. and *defodiens* Mann. are the only species of this group that I have seen. They are closely related, almost enough so for the latter to be considered the North American subspecies of the former. *Defodiens* occurs from Nfld., N. S.,

and N. J. through Que., Mich., Wisc., Minn., Man., Alb., and Mont. to central Calif. and Alaska.

KEY TO ABERRATIONS OF N. DEFODIENS MANN.

A1. Humeral end of hypomera orange.
  B1. Fasciæ not united on disc; N. J. to Alb.....ab. **humeralis** Hatch.
  B2. Fasciæ united on disc by double connection; Mich. (Type: Ag. Coll. 20, Aug. 1916 .....ab. **ruber** nov.
A2. Humeral end of hypomera black.
  B1. Posterior spot large; anterior spot not constricted.
    C1. Fasciæ not united on disc.
      D1. Anterior fascia not interrupted by suture; Me., N. Y., Ont., Minn., Dakota.....**type.**
      D2. Anterior fascia interrupted by suture; N. B., Me. (Type: Cumberland Co., A. Nicolay)
        ab. **nicolayi** nov.
    C2. Fasciæ united by single connection; Ore. (Type: Baker City, Aug. 5, 1906) .....ab. **oregonensis** nov.
  B2. Posterior spot small.
    C1. Anterior fascia continuous, constricted.
      D1. Hypomera orange in part; B. C., Calif. (Type: Del-norte Co., V-29-10, F. W. Nunemacher).
        ab. **nunemacheri** nov.
      D2. Hypomera black; Calif.....ab. **binotatus** Port.
    C1. Anterior fascia broken; posterior spot small.
      D1. Inner end of anterior fascia large.
        E1. Hypomera orange in part; Wash. to Cal.
          ab. **lateralis** Port.
        E2. Hypomera black; Calif. (Type: Sonoma Co.)
          ab. **pacificae** nov.
      D2. Inner end of anterior fascia reduced; Ore., Wash. (Type: Mason Co., Wash. Lake Cushman, vii-15–1919, F. M. Gaige 103).....ab. **gaigei** nov.
      D3. Inner end of anterior fascia absent; Cal., Ore.
        ab. **conversator** Walk.
  B3. Posterior spot absent.
    C1. Anterior fascia not constricted; Alaska.
      *ab. **kadjakensis** Port.
    C2. Anterior fascia constricted; Calif.....ab. **mannerheimi** Port.

Pustulatus Group

KEY TO SPECIES

A1. Metasternal pubescence yellow, if black with immaculate elytra.
  B1. Metaepimeron glabrous.

C1. Elytral margin normal, not attaining humerus; hypomera orange or, if not, the elytra is immaculate; elytra without longitudinal raised lines.

D1. Abdominal pubescence yellow only at tip of pygidium; Palaearctic; in North America from Alaska and Man. through Colo. to N. Mex. and Calif., (?) Va. **investigator** Zett.

D2. Abdominal pubescence yellow over entire pygidium and along margins of propygidium; Japan. ***latifasciatus** Lewis

C2. Elytral margin much longer; hypomera faintly orange; elytra with distinct raised longitudinal lines; Kurile Is. and Sitka (Portevin), Man., Minn. and Newfoundland to Colo., Tex., and Fla., (?) Calif.....**pustulatus** Hersch.

B2. Metaepimeron pubescent; margin of pronotum somewhat narrower (as in *sepultor*).

C1. Hypomera entirely orange; abdominal hairs yellow; eastern Siberia, Japan.....***praedator** Reitt.

C2. Hypomera with black; abdominal hairs yellow or black; Palaearctic .....**fossor** Er.

A2. Metasternal pubescence brown; abdominal pubescence black; never immaculate.

B1. Pronotum subquadrangular; Mexico: Durango, Michoacan. **mexicanus** Matth.

B2. Pronotum trapezoidal; Tibet, north China.....**semenowi** Reitt.

Investigator Zett. is distributed from Europe eastward to central North America. Along the Pacific Coast from Japan to British Columbia the anterior fascia becomes reduced to form the subspecies *maritimus* Mann., and in California and Oregon, in the subspecies *nigritus* Mann., the elytra is immaculate.* Closely related to *investigator* Zett. is *pustulatus* Hersch., which occurs in eastern North America,* and might possibly be regarded as another subspecies. Portevin reports it likewise from the Kurile Is., and Sitkha, showing that its center of origin may be the same as *maritimus* Guer. It is similarly characterized by a reduction of the anterior fascia. Typical *investigator* is not entirely absent from the Pacific Coast (B. C. to Ore.) but is apparently not dominant there.

* There are in the author's collection single specimens of *nigritus* Mann. labeled "Va." and of *pustulatus* Hersch. labeled "Cal,", but both records require confirmation.

KEY TO SUBSPECIFIC CATEGORIES OF *N. INVESTIGATOR* ZETT.

A1. Elytra maculate; sternal pubescence yellow.

B1. Elytral fasciæ entire; throughout range of species except region from Japan to Calif.....subsp. **investigator** (s. str.)

C1. Elytral fasciæ not united on disc.

D1. Hypomera orange.

E1. Punctation normal .....**type.**

E2. Punctation coarse, dense, confluent; fasciæ large. *var. **variolosus** Port.

D2. Hypomera with black spot towards base.

E1. Black spot small.

F1. Posterior fascia confluent with hypomera, Moravia, Ariz., N. M., Man., Utah, Ore., Wash., Alb., B. C.....ab. **intermedius** Reitt.

F2. Posterior fascia not confluent with hypomera; Ariz., N. Mex. (Type: Hot Springs, 7000 ft. alt.), Wash., Mont. ab. **jamezi** nov.

E2. Black spot large so that entire humeral portion of hypomera is black except a narrow margin. *ab. **funeror** Reitt.

C2. Elytral fasciæ united on disc; Ariz., N. Mex. ab. **lutescens** Port.

B2. Anterior fascia more or less reduced; Japan to B. C. subsp. **maritimus** Guér.

C1. Discal portion of anterior fascia continuous with hypomera.

D1. Anterior fascia attaining suture; B. C. (Type: Massett, Sept. 1925, Jack Martin col.).....ab. **martini** nov.

D2. Anterior fascia not attending suture; B. C. (Type: Massett, July 26, 1925, Clarence Martin col.) ab. **clarencei** nov.

C2. Discal portion of anterior fascia not continuous with hypomera.

D1. Anterior fascia with 3 free elements: 2 discal, 1 sutural; B. C., Alaska .....**type of subspecies.**

D2. With 2 free elements, discal and sutural; Sitka (Type: Sitk. 578), B. C.....ab. **sitkenensis** nov.

D3. One free discal element; B. C. (Type: Massett, July 26, 1925, Clarence Martin col.).....ab. **massetti** nov.

D4. One sutural element; B. C. (Type: Massett, July 26, 1925, Clarence Martin col.).....ab. **grahami** nov.

D5. One element, sutural plus discal; B. C. (Type: Massett, Sept. 1925, Jack Martin col.) ab. **charlottei** nov.

C3. Discal portion of anterior fascia absent.
D1. Posterior fascia entire; Turemenie, Sitka, B. C.
ab. **particeps** Fisch.
D2. Posterior fascia divided; Japan (Type)
ab. **japani** nov.
A2. Elytra immaculate; sternal pubescence brown; Calif., Ore.
subsp. **nigritus** Mann.
B1. Abdominal pubescence yellow; Calif. .....*var. **ruficornis** Mots.
B2. Abdominal pubescence black; Calif., (?) Va. .....**type of subsp.**

KEY TO ABBERATIONS OF *N. PUSTULATUS* HERSCH

A1. Discal element of anterior fascia present.
B1. Spots of posterior fascia joined; Colo. (Type)
ab. **coloradensis** nov.
B2. Spots of posterior fascia separate; N. Y. (Type: Amagansett, L. I., W. T. Davis. Sept., 1916).....ab. **noveboracensis** nov.
A2. Discal element of anterior fascia absent.
B1. Spots of posterior fascia joined; Ken., Que., N. Y., Fla.
ab. **fasciatus** Port.
B2. Spots of posterior fascia separate; throughout range of species, (?) Calif. .....**type**
B3. Elytra immaculate; La. (Univ. of Minn. coll.) .....ab. **unicolor** Port.

Marginatus Group

KEY TO SPECIES

A1. Posterior tibiæ straight; margin of pronotum narrower than in *pustulatus* but wider than in the other species of this group; pronotum finely punctate.
B1. Pronotum feebly cordate; sternal pubescence yellow throughout; base of hypomera with black spot; Europe to Lake Baikal.
sepultor Charp.
B2. Pronotum more strongly cordate; sternal pubescence dark at sides; base of hypomera with black spot.
C1. Sternal pubescence yellow at middle; northern Mongolia, eastern Siberia .....**pseudobrutor** Reitt.
C1. Sternal pubescence dark at middle; China....***confusus** Port.
B3. Pronotum very strongly cordate; sternal pubescence yellow throughout; hypomera entirely orange; Wash., Mont., Man., Minn., (?) N. M. and (?) N. J. .....**hybridus** Hatch and Angell
A2. Posterior tibiæ very feebly arcuate on inner margin, sinuate on outer margin; disc coarsely punctate, margin narrow; anterior lines of pronotum nearly attaining mid-dorsal line.
B1. Abdominal hairs black; Alas. and Calif. to Man., Wyom., Colo., Kans., and N. Mex. .....**guttulus** Mots.

B2. Abdominal hairs yellow; northern China, eastern Siberia.
basalis Fald.

A3. Posterior tibiæ strongly arcuate along both margins; disc of pronotum less strongly punctate, margins narrow; anterior lines of pronotum not attaining mid-dorsal line.

B1. Margin of thorax wider; abdominal hairs yellow; central China, Mongolia, Chosen, Japan, Formosa .....**japonicus** Har.

B2. Margin of pronotum narrower; abdominal hairs black.

C1. Basal segment of antennal club black; Man., N. D., S. D., Ore., Ut., Minn., Wisc. .....**obscurus** Kby.

C2. Antennal club orange; Me., Man., Alb., and Ore. to Calif., Tex., and Miss.; Mexico and Central America (?)
marginatus Fab.

Nicrophorus hybridus Hatch and Angell.—The New Mexico and New Jersey records are founded on single specimens and require confirmation. A single specimen from Minnesota (Ramsey Co.) with entirely black antennæ—in the typical form only the basal segment is black—exists in the University of Minnesota and constitutes the var. *minnesotianus* Hatch.

Nicrophorus guttulus Mots.—Along the Pacific Coast from Oregon to California this species is represented by the subspecies *guttula* (s. str.), in which the basal segment of the antennal club is black and the elytral markings reduced or absent. Throughout the rest of its range occurs the subspecies *hecate* Bland., in which the antennal club is entirely orange and the maculation normal. However, some forms of *hecate* (*californiæ* from California and *intermedius* from Oregon and Nevada) occur in the same region as *guttula* (s. str.), and their reduced maculation would seem to show that this rather than the color of the antennal club is the geographically significant variation.

KEY TO SUBSPECIFIC CATEGORIES OF *N. GUTTULUS* MOTS.

A1. First segment of antennal club black; Ore., Calif.
subsp. **guttulus** Mots.

B1. Anterior fascia continuous with hypomera.

C1. Posterior fascia single; Cal. (Type: Sonoma Co., Mar. 25, 1912) .....ab. **punctatus** nov.

C2. Posterior fascia in two parts; Cal. (Type: Shasta Co., May, 1914) .....ab. **shastæ** nov.

B2. Anterior fascia discontinuous, in two parts.

C1. Posterior fascia bilobed.
D1. Hypomera red; Cal. .....ab. **quadriguttatus** Angell.
D2. Hypomera black behind humeral spot; Cal. (Type: Shasta Co., May, 1914) .....ab. **hypomerus** nov.
C2. Posterior fascia divided; Cal. (Type: San Francisco, VIII–26–1911) .....ab. **sanfranciscæ** nov.
B3. Anterior fascia wanting.
C1. Posterior spot present.
D1. Hypomera red; Cal. .....ab. **vandykei** Angell.
D2. Hypomera dark behind humeral spot; Cal. (Type: San Francisco, VIII–26–1911, J. A. Kusche col.) ab. **kuschei** nov.
C2. Posterior spot absent.
D1. Hypomera red; Cal. (Type: San Francisco, VIII–26–1911, J. A. Kusche col.) .....ab. **lajollæ** nov.
D2. Hypomera dark behind humeral spot; Ore., Cal. **type of subsp.**
A2. Antennal club orange; throughout range of species except coast from Ore. to Cal. (but cf. *californiæ intermedius*, and *immaculosus*). subsp. **hecate** Bland.
B1. Fasciæ not united on disc.
C1. Anterior fascia entire.
D1. Posterior fascia continuous with hypomera; B. C., Wash., Ore., Wyom., Ut., Colo., N. M. ....**type of subsp.**
D2. Posterior fascia not extending to lateral margin.
E1. Posterior fascia elongate; B. C. (Type: Peachland, B. C., 3–VIII–12, J. B. Wallis, under carrion), Ore., Nev., N. M., Wyom. .....ab. **wallisi** nov.
E2. Posterior fascia a round spot; Cal. (Type) ab. **californiæ** nov.
C2. Anterior fascia discontinuous.
D1. Posterior fascia single, anterior in two parts; Ore., Nev. .....ab. **intermedius** Angell.
D2. Posterior fascia in two parts, anterior in three parts. ab. **disjunctus** Port.
B2. Fasciæ united on disc.
C1. Connection of fasciæ single.
D1. Posterior black spot of elytra not constricted.
E1. Connection of fasciæ narrow; Colo., N. M. (Type: Jamez Springs, N. M., 1915, John Woodgate) ab. **woodgatei** nov.
E2. Connection of fasciæ broad; Ariz. (Type: Phoenix), Colo., N. M., Nev. .....ab. **phoenix** nov.
D2. Posterior black spot on elytra nearly divided; Colo., N. M. (Type: Fort Wing, N. M.) ....ab. **novamexicæ** nov.
C2. Connection of fasciæ double.

D1. With dark sutural space; N. M., Cal., Kans.
ab. **rubripennis** Port.

D2. Without dark sutural space; Colo. (Type)
ab. **rubrissimus** nov.

B3. Disc immaculate; Calif. (Type in collection of Deutsche Entomologische Institut .....ab. **immaculosis** nov.

KEY TO ABERRATIONS OF *N. OBSCURUS* FAB.

A1. Elytral fasciæ not continuous on disc.
B1. Posterior fasciæ entire .....**type**
B2. Posterior fasciæ divided, with sutural lobe reduced to 2 free spots, anterior fascia broken; Utah (Type in collection of Phil. Acad. Nat. Sci.) .....ab. **discontinuus** nov.
A2. Elytral fasciæ continuous on disc; Ore. (Type: Portland, Ore., 7–16–1917, M. T. Goe col.), Wisc. .....ab. **ruber** nov.

KEY TO ABERRATIONS OF *N. MARGINATUS* FAB.

A1. Elytral fasciæ not connected on disc.
B1. Both fasciæ continuous, posterior one extending more than half way to suture .....**type**
B2. Anterior fascia discontinuous; Colo. (Type: Oslar, San Juan Mts., Colo.), Wisc., N. Y. .....ab. **sanjuanæ** nov.
B3. Posterior fascia discontinuous; Cal. (Type: La Jolla, San Diego Co., Cal., 1924, Engelhardt col.) .....ab. **engelhardti** nov.
B4. Posterior fascia abbreviated, extending less than half way to suture; Cal. (Type: San Francisco, VII–16–1911)
ab. **leachi** ov.
A2. Elytral fasciæ connected on disc; N. Y., Ark. .....ab. **cordiger** Port.

The aberrations *engelhardti* and *leachi* from California exhibit the same tendency towards a reduction of the elytral fasciæ as is seen in other species in this region.

Vespillo Group

KEY TO SPECIES

A1. Pronotum pubescent throughout; posterior tibiæ straight.
B1. Pronotum sparsely pubescent on disc.
C1. First segment of antennal club black; Europe to Mongolia.
vestigator Hersch.
C2. Antennal club orange; central Europe to Mongolia.
antennatus Reitt.
C3. Antennal club black; Mongolia, eastern Siberia.
dauricus Mots.

B2. Pronotum densely pubescent on disc; antennal club black; Me., Ont., Man., Mont., and Ore., through Colo. to (?) Lower Calif., Ariz. and Georgia .....**tomentosus** Web.*

A2. Pronotum pubescent in front only; posterior tibiæ curved.

B.1. First segment only of antennal club black; posterior tibiæ strongly curved; Palæarctic, northern India, (?) Nebr. and Penn. (Portevin) .....**vespillo** L.

B2. Antennal club black; posterior tibiæ feebly curved; central Europe, Greece, Caucasus .....**nigricornis** Fald.

Nicrophorus vestigator ab. **abbrevius** nov.—Those specimens in which the posterior fascia attains neither the hypomera or suture are so designated. My specimens are from England (Type: s. coast, England) and Germany.

Nicrophorus antennatus ab. **transbaikali** nov.—A single specimen in my collection from the Transbaikal in which the posterior fascia fails to attain the suture.

KEY TO ABERRATIONS OF *N. TOMENTOSUS WEB.*

A1. Fasciæ not confluent on disc.

B1. Fasciæ joined on hypomera.

C1. Posterior fascia entire.

D1. Posterior fascia not interrupted at suture .....**type**

D2. Posterior fascia interrupted at suture (Type: Wyandanche, L. I., Oct. 10, 1915, F. M. Schott)
ab. **communis** nov.

C2. Posterior fascia with free sutural spot.
*ab. **angustefasciatus** Port.

B2. Fasciæ joined mesad of hypomera; Colo. (Type: Littleton, Colo. VI–24–11, C. A. Frost, dead bird) .....ab. **elongatus** nov.

A2. Fasciæ continuous on disc.

B1. Elytral disc with single dark spot; Ariz. (Type: Flagstaff, Ariz.) .....ab. **splendens** nov.

B2. Elytral fasciæ forming a solid discal mass (on one elytron only); Man. (Type: Aweme, Man. 14–VIII–06, Criddle).
ab. **brevis** nov.

Nicrophorus vespillo ab. **germani** nov.—A single specimen from Germany in which the posterior elytral fascia fails to attain the sutural bead of the elytra.

Subg. **Necrocharis** Port.

Carolinus L., the single species of this group, occurs in N. C., Fla., La., Tex., N. Mex., Ariz., Okla., Kans., Nebr., and (?) Penn.

* Sherborn (Index Animalium, 1922, p. cxxviii) says that Weber, Obs. Ent. 1801, probably antedates Fabricius, Syst. Eleut. I, 1801, giving *tomentosus* Web. priority over *velutinus* Fab.

KEY TO ABERRATIONS OF *N. CAROLINUS* L.

A1. Elytra maculate.
B1. Hypomera orange, at least at base.
C1. Basal fascia entire.
D1. Basal fascia extending on to hypomera.
E1. Basal fascia and humeral spot broadly connected. **type**
E2. Basal fascia and humeral spot narrowly connected; N. C. (Type: Southern Pines, N. C., VI–28–16, A. H. Manee), Fla. .....ab. **floridæ** nov.
D2. Basal fascia not extending on to hypomera.
E1. Apical lunule without partially enclosed spot immediately anterior; N. C., Fla. ab. **scapulatus** Port.
E2. Apical lunule partially enclosing a spot immediately anterior; Fla. (Type: Stemper, Fla., George Krautwurm).....ab. **krautwurmi** nov.
C2. Basal fascia divided.
D1. Hypomera orange; N. M. (Type: Tbu'que, N. M., 70–10–88 .....ab. **lunulatus** nov.
D2. Hypomera black except cephalad; Neb., Kans. (Type), N. M. .....ab. **nebraskæ** nov.
B2. Hypomera entirely black .....*ab. **dolosus** Port.
A2. Elytra immaculate; hypomera black, faintly orange cephalad; Ariz. ab. **mysticalis** Angell

Ptomascopus Kr.

KEY TO SPECIES

A1. Occiput densely punctate; elytra with 3 or 4 rows of large punctures; pronotum with a basal fovea on either side of middle.
B1. Elytra densely punctate, with a single anterior fascia.
C1. Less shining, more pubescent; 15 mm. long; northern China, Japan .....**plagiatus** Mén.
C2. More shining, less pubescent; eastern Siberia. ***weberi** Boden.
B2. Elytra finely punctate, immaculate; 15 mm. long; northern China, Japan, Formosa .....**morio** Kr.
A2. Occiput less densely punctate; elytra densely punctate; large punctures wanting from elytra; basal pronotal foveæ scarcely evident; color of elytra unknown; 14.5 mm. long; Lower Oligocene of France. ***aveyronensis** Flach.

V. FOSSILS

Are there Mesozoic Silphinæ?—Two types of elytra may be suspected in this connection: (1) nine-striated elytra of caraboid facies without a sutural stria; (2) tri-costate elytra.

The nine-striated elytron represents a generalized type widely distributed in Carabidæ and Tenebriondæ. Both these families have a sutural stria, which is absent in Lyrosomini and Agyrtini. *Pseudocarabites deplanatus* Heer (Handlirsch, Foss. Ins. 1908, p. 401, Taf. XXXIX, fig. 9), founded on a nine-striated elytron 5 mm. long, from the Upper Trias of Sweden, may possibly be suspected of lyrosomin or agyrtin affinities. However, the basal portion of the elytron appears to be lost, so that the existence of a sutural stria is indeterminable.

The tri-costate condition is found in several of the elytra figured by Handlirsch (*ibid.*), to wit, Taf. XLI, fig. 62, 75; Taf. XLV, fig. 6, 27, 61, 63, 77. None of these, however, except the last, exhibit the large scutellum that is characteristic of *Silpha,* and this appears to be too convex to admit it to this group. Furthermore, the pronotum of Taf. XLV, fig. 6 makes it inadmissible. Taf. XLI, fig. 75 is a fragment showing an elytral apex. In its convergent striæ and apparently narrow elytra it more closely resembles such a buprestid as *Buprestes striata* than *Silpha.*

I find nothing suggesive of *Nicrophorus* in any of the mesozoic fossils figured.

AGYRTINI

Agyrtes Fröl.

A. primoticus S. Scudder (fig. 1) (Adephagous and Clavicorn Coleoptera from the Tertiary deposits at Florissant, Colorado. U. S. G. S. Mong. XL, 1900, p. 45, pl. V, fig. 6) Upper Miocene of Florissant, Colo. Length 8 mm., bredth 4.1 mm. Elytra nine-striate; antennæ clavate. Pronotum as wide at base as elytra with sides feebly arcuate, about 55 per cent. as long as wide at base, and with apex somewhat narrower than base. The subquadrate pronotum reveals this as *Agyrtes,* though none of the living species attains a length of more than 5 mm.

Miosilpha Wick.

M. necrophiloides Wickham (fig. 2 and 3). (A report on some recent collections of fossil Coleoptera from the Miocene shales of Florissant. Bull. Univ. of Ia. Lab. Nat. Hist. VI (3), 1912, p. 9, pl. I, fig. 5, 6.) Length to apex of abdomen 9 mm., length of elytra 3.5 mm. Sufficiently defined above in the key to the genera of Silphinæ.

Ipelates Reitt.

Klebs (Schr. Phys. ökon. Gesell. Königsburg LI, 1910, p. 241) records an unidentified species of this genus from the Lower Oligocene of Baltic Amber. The identification was by Reitter.

SILPHINI

Silpha L.

Subg. *Oeningosilpha* nov.

Silpha (Oeningosilpha) tricostata Heer (fig. 4). (*Peltis tricostata* Heer, Die Insektenfauna der Tertiargebilde von Oeningen und von Radoboj in Croatien. Käfer. Mem. Soc. Helv. sci. nat., Neuchatel, VII, 1845, pp. 39–40, pl. VII, fig. 34.) Based on an elytron 5⅝ lines (14.15 mm.) long from the Upper Miocene of Oeningen, Baden. The subgenus *Oeningosilpha* (type *Peltis tricostata* Heer) is distinguished from the other recent subgenera by the fact that the distance between the margin and the outer stria of the elytron is equal to that between the outer stria and the suture. In recent subgenera the first distance is less than the second. The pronotum is unknown, and, if it should be orbicular, would require the inclusion of this subgenus in *Necrodes*.

Subg. *Thanatophilus* Sam.

Silpha (Thanatophilus) dispar Herbst is merely mentioned by Heer (Die Urwelt der Schweiz, 2nd ed., 1883, p. 581) from the Pleistocene and by Alfred Bell (Post-glacial insects, Entom. XXI, 1888, p. 2) from the Norfolk Forest bed.

Subg. *Blitophaga* Reitt.

Silpha (Blitophaga) vestusta A. M. Lomnicki (fig. 5) (Pleistocenskie Owady z Boryslawia (Fauna pleistocenica Insectorum Boryslaviensium). Museum Im. Dzieduszyckich IV. Lemberg, 1894, p. 76, pl. 7, fig. 59). Lower Pleistocene of Boryslaw, Galicia.

Silpha (Blitophaga) reitteri Lomnicki (fig. 6) (*ibid.*, p. 77, pl. 7, fig. 60). Lower Pleistocene of Boryslaw, Galicia.

The transverse pronotum, feebly narrowed and not emarginate in front reveal these as *Blitophaga.* The basal margin of the pronotum is represented as being straighter and less sinuate than in any of the living species I have seen, but this is a more or less evanescent character that figures cannot always be relied upon to depict accurately. The two species are distinguished by size and by the varying extent of the inner elytral costa. I do not feel sufficiently familiar with the numerous species of *Blitophaga* to discuss their detailed relationships.

Subg. *Silpha* (s. str.)

S. beutenmuelleri Wickham (fig. 7) (New Miocene Coleoptera. Bull. Mus. Comp. Zool. LVIII, 1914, p. 428, pl. I, fig. 3). Upper Miocene of Florissant, Colo. Described from a coarsely punctate elytron a trifle over 10 mm. long. From the figure one would suppose that there were four entire costae, but the author says that the outer of these is a deep marginal groove, and he compares it with the living *tyrolensis.* The great distance of the groove and the outer costa from the margin, the entire outer costa, and the obsolescence of the elytral tuberosity appear to distinguish this fossil from any of the living species known to me. It is almost certainly a member of the subgenus *Silpha,* a group which is now confined to the Palaearctic region with three species in Ethiopian Africa. As regards development and position of the groove, it approximates *carinata,* but in that species the outer costa is abbreviated apically.

NECRODINI

Necrodes Leach

Subg. *Mionecrodes* nov.

Necrodes (Mionecrodes) tricostata Heer (figs. 8 and 9) (*Silpha tricostata* Heer, Beitrag zur Insekten-fauna Oeningen, Coleoptera. Naturk. Verh. Hollandsche Maatsch. Wetensch. Haarlem XVI, 1862, pp. 50–51, pl. III, figs. 7–8). Upper Miocene of Oeningen, Baden. The position of the outer elytral costa nearer the margin than the suture shows that this is not the same as *Peltis tricostata* Heer 1845 (*Oeningosilpha* above). The oval pronotum of Heer's fig. 7 (fig. 8) places it in *Necrodes,* but it is separated from the living species by the broader, less elongate, entire (not truncate) elytra. With this species Heer associated the specimen depicted in fig. 9. The pronotum of the second specimen is unknown. I detect differences between the two, but hesitate to recognize two species.

Subg. (?) *Protonecrodes* Port.

Necrodes primaevus Beutenmüller and Cockerell (in Cockerell, Fossil Insecta from Florissant, Colorado. Bull. Amer. Mus. Nat. Hist. XXIV, 1908, p. 67, pl. C, fig. 1). Upper Miocene of Florissant, Colo. Length 17 mm. Elytra 11 mm. long. Similar to *surinamensis* Fab., but with shorter elytra. The half-tone figure is not good and a restudy of the type might reveal additional features.

NICROPHORINI

Ptomascopus Kr.

P. aveyronensis K. Flach (fig. 10) (Ueber zwei fossile Silphiden Coleoptera) aus den Phosphoriten von Caylux. Deut. Ent. Zeit. 1890, p. 106, Taf. I, fig. 2). Lower Oligocene of the Phosphorit of Aveyron von Caylux, southern France. Sufficiently described above in the key to the species of *Ptomascopus.*

Palaeosilpha Flach

P. fraasii Flach (fig. 11) (*ibid.,* pp. 106–107, Taf. I, fig. 1). Lower Oligocene of the Phosphorit of Aveyron von Caylux,

southern France. Sufficiently described above in the key to the groups of Nicrophorini.

NOT SILPHINAE

Staphylinidae

Silpha stratuum Germar (Fauna Insectorum Europae XIX, 1837, tab. 5). This is not Silphinae, because five or six abdominal tergites are exposed by the slightly transverse elytra. I do not attempt to place it further.

Ostomidae

Phosphuga atrata Flach nec L. (Die Käfer der unterpleistocänen Ablagerungen bei Hosbach unweit Aschaffenburg. Verh. Phys. Med. Gesell. Wurzburg, N. F. XVIII, 1884, p. 9, pl. IX, fig. 6). Based on a single elytron. The small scutellum makes the assignment of this species to any of the living subgenera of *Silpha* impossible, and it is this character which I rely upon to establish its cogenericity if not its cospecificity with *Zimioma grossa* L. Of course, there is a possibility that this is the remains of a *Silpha* with a small scutellum, but the above assignment seems the more probable.

Melandryidae

Silpha colorata Scudder (*ibid.*, p. 44, pl. V, fig. 5). The absence of striae or costae, and the finely pubescent, narrow, and apically rounded elytra make the assignment of this fossil to Silphinae impossible. The only living species with which I can compare it is *Emmesa connectens* Newm., from which it is separated by the failure of the apical spot to attain the apex of the elytra.

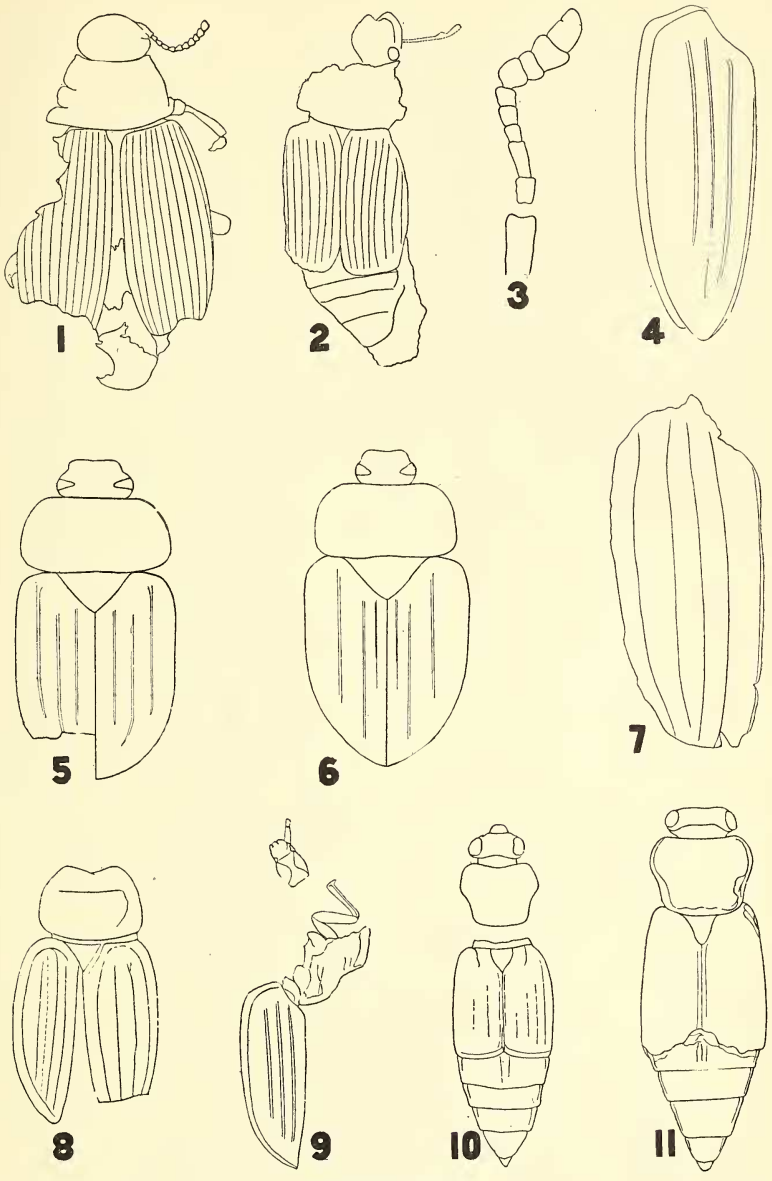
Coleoptera incertae sedis

Silpha obsoleta Heer (1845, *ibid.*, p. 36, pl. II, fig. 7). This species is founded on an impression showing a head, pronotum, and apparently a portion of the elytra. No suture is revealed and no sculpture is present. To attempt the classification of such an object is folly!

Silpha ? deplanata Heer (Die Miocene Flora und Fauna Spitsbergen, K. Svenska Vet. Ak. Handl. VIII (7), 1870 (1869), p. 73, pl. 16, fig. 42). Based on the fragment of an elytron about 11 mm. long and 5 mm. wide. Flat with a broad margin and a number of flat longitudinal ridges which Heer says is five, but which is indeterminable from the figure. I do not believe the assignment of this fossil to *Silpha* is warranted. No quintecostate recent silphine is known. At best, such a condition is a more or less generalized one, found in several families.

EXPLANATION OF PLATE XVI

Figure 1: *Agyrtes primoticus* Scudder (1900, Pl. V, Fig. 6); Figures 2–3: *Miosilpha necrophiloides* Wickham (1912, Pl. I, Figs. 5, 5a); Figure 4: *Silpha* (*Oeningosilpha*) *tricostata* Heer (1845, Pl. VII, Fig. 34); Figure 5: *Silpha* (*Blitophaga*) *vetusta* Lomnicki (1894, Pl. 7, Fig. 59); Figure 6: *Silpha* (*Blitophaga*) *reitteri* Lomnicki (1894, Pl. 7, Fig. 60); Figure 7: *Silpha* (s. str.) *beutenmuelleri* Wickham (1914, Pl. I, Fig. 3); Figures 8–9: *Necrodes* (*Mionecrodes*) *tricostata* Heer (1862, Pl. II, Figs. 7–8); Figure 10: *Ptomascopus aveyronensis* Flach (1890, Taf. I, Fig. 2); Figure 11: *Palaeosilpha fraasii* Flach (1890, Taf. I, Fig. 1).



SILPHINAE